

**REMARKS**

Claims 1-18 are pending in this application. By this Amendment, claims 1, 2, 4, 5 and 7 are amended and new claim 18 is added. Claims 1, 2, 4 and 5 are amended to address the teachings of Nikolaev et al., while claim 7 is amended to address the teachings of Shibata et al.

Support for the amendments to claims 1, 2, 4, 5 and 7 and new claim 18 can be found in original claim 7 and throughout the specification at, for example, page 7, lines 21-26, page 12, lines 6-9 and 17-22, page 17, lines 17-24, page 18, lines 15-22 and page 19, lines 18-26. No new matter is added to the application by this Amendment.

Reconsideration of the application is respectfully requested.

**I. Rejection under 35 U.S.C. §102(b)**

Claims 7-11 and 14-17 were rejected under 35 U.S.C. §102(b) as allegedly being anticipated by EP 1184488 A2 to Shibata et al. Applicants respectfully disagree.

The Patent Office alleges that Shibata et al. discloses all limitations recited in claims 7-11 and 14-17.

Applicants submit that Shibata et al. fails to disclose an apparatus for producing an Al-containing III-V group compound semiconductor by growing its crystal by hydride vapor phase epitaxy in a reactor having a single wall reaction chamber made only of quartz as recited in amended claim 7.

On the contrary, Shibata et al. discloses (1) that the reactor is made of an aluminum nitride material (see Abstract); (2) that the whole reactor of Fig. 1 is made of an aluminum nitride material that is not corrodible by an AlCl gas and which has a hexagonal or a cubic crystal structure; (3) that the reactor body 11a in Fig. 2 is made of a silicon oxide-based material such as quartz coated with an aluminum nitride film 11b; (4) that the reactor 11 in Fig. 3 has a first reactor part 11-1 made of a quartz material, a second reactor part 11-2 made

of aluminum nitride material and a third reactor part 11-3 made of a quartz material; and (5) that the apparatus in Fig. 4 has an inner quartz reactor 31 and an outer quartz reactor 32.

None of these embodiments is a single wall reactor composed solely of quartz. Therefore, Shibata et al. fails to teach a single wall reaction chamber made only of quartz as required in claim 7.

In view of the foregoing, Shibata et al. fails to disclose each and every limitation of independent claim 7 and thus cannot anticipate claim 7, or any of the additional features recited in the dependent claims thereof. Accordingly, reconsideration and withdrawal of this rejection are respectfully requested.

## **II. Rejections Under 35 U.S.C. §103(a)**

### **A. Nikolaev et al.**

Claims 1 and 3 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over U.S. Patent No. 6,218,269 to Nikolaev et al. This rejection is respectfully traversed.

Applicants submit that Nikolaev et al. fails to teach or suggest a method for growing a crystal of an Al-containing III-V group compound semiconductor having a second step of reacting the halogenated product of Al with a gas containing a group V element at a temperature of 1200°C to 1300°C on the surface of a substrate crystal as recited in claim 1.

Nikolaev et al. merely teaches a process which is carried out in a temperature range from 900 to 1200°C (see Abstract). Further, Nikolaev et al. teaches that during the growth, the substrate is kept at a growth temperature of from 800 to 1100°C (see col. 2, lines 9 and 10). Still further, Nikolaev et al. teaches the temperature ranges from 800 to 1200°C for different epitaxial runs (see col. 8, lines 12-15).

Thus, Nikolaev et al. fails to disclose a second step of reacting the halogenated product of Al with a gas containing a group V element at a temperature of 1200°C to 1300°C on the surface of a substrate crystal as required in claim 1.

Because this feature of independent claim 1 is not taught or suggested by Nikolaev et al., Nikolaev et al. would not have rendered the features of claims 1 and 3 obvious to one of ordinary skill in the art.

For at least these reasons, claims 1 and 3, are patentable over the applied reference. Thus, withdrawal of the rejection under 35 U.S.C. §103(a) is respectfully requested.

**B. Nikolaev et al. in view of Shibata et al. and Vaudo et al.**

Claims 4 and 6 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Nikolaev et al. in view of Shibata et al. and U.S. Patent No. 6,533,874 to Vaudo et al. The rejection is respectfully traversed.

Applicants submit that none of Nikolaev et al., Shibata et al. and Vaudo et al., taken singly or in combination, teach or suggest a method for growing a crystal of an Al-containing III-V group compound semiconductor having second step of reacting the halogenated product of Al with a gas containing a group V element at a temperature of 1200°C to 1300°C on the surface of a substrate crystal as recited in claim 4. Moreover, Applicants submit that none of Nikolaev et al., Shibata et al. and Vaudo et al., taken singly or in combination, teach or suggest that at least one of the amount of the halogenated hydrogen used in the first step, the amount of a carrier gas for the halogenated hydrogen used in the first step, and the amount of the group V element-containing gas used in the second step is varied to deposit III-V group compound semiconductors having different compositions as required in claim 4.

As discussed with respect to claim 1, Nikolaev et al. fails to teach a step of reacting the halogenated product of Al with a gas containing a group V element at a temperature of 1200°C to 1300°C. Shibata et al. merely teaches a system that has an upstream that is heated up to 900°C and a downstream that is heated up to 1000°C and thus doesn't remedy the deficiencies of Nikolaev et al.

Nowhere does Nikolaev et al., Shibata et al. and Vaudo et al., taken singly or in combination, teach or suggest that at least one of the amount of the halogenated hydrogen used in the first step, the amount of a carrier gas for the halogenated hydrogen used in the first step, and the amount of the group V element-containing gas used in the second step is varied to deposit III-V group compound semiconductors having different compositions. Vaudo et al. at best teaches that a composition of the (Ga, Al, In)N is controlled by the flow of HCl over each metal as well as by the substrate temperature and by the temperature of each metal. Nowhere does Vaudo et al. teach or suggest that the amount of the halogenated hydrogen used in the first step and the amount of the group V element-containing gas used in the second step are varied as defined in claim 4.

Because these features of independent claim 4 are not taught or suggested by Nikolaev et al., Shibata et al. and Vaudo et al., taken singly or in combination, these applied references would not have rendered the features of claims 4 and 6 obvious to one of ordinary skill in the art.

For at least these reasons, claims 4 and 6 are patentable over all the applied references. Thus, withdrawal of the rejection under 35 U.S.C. §103(a) is respectfully requested.

**C. Nikolaev et al. in view of Solomon et al.**

Claims 2 and 12 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Nikolaev et al. in view of International Patent Application Publication No. WO 00/68470 A1 to Solomon et al. The rejection is respectfully traversed.

Applicants submit that neither Nikolaev et al. nor Solomon et al., taken singly or in combination, teach or suggest a method for growing a crystal of an Al-containing III-V group compound semiconductor containing Al as a group III element by vapor phase epitaxy having a second step of reacting the halogenated product of group III produced in the first step with a

gas containing a group V element at a temperature of 1200°C to 1300°C on the surface of a substrate crystal as recited in claim 2.

As discussed with respect to claim 1, Nikolaev et al. fails to teach or suggest a step of reacting the halogenated product of Al with a gas containing a group V element at a temperature of 1200°C to 1300°C. Solomon et al. merely teaches that first and second reagent gas components react in a reactor to form a p-type nitride layer which is deposited on a substrate (see page 13, lines 18-21). Further, Solomon et al. teaches that after growth of the layer as a relatively thick film, the layer may be removed from the substrate to provide a p-GaN substrate. Therefore, Nikolaev et al. and Solomon et al., taken singly or in combination, fail to teach or suggest a second step of reacting the halogenated product of group III produced in the first step with a gas containing a group V element at a temperature of 1200°C to 1300°C on the surface of a substrate crystal as required in claim 2.

Because this feature of independent claim 2 is not taught nor suggested by Nikolaev et al. and Solomon et al., taken singly or in combination, Nikolaev et al. and Solomon et al. would not have rendered the features of claims 2 and 12 obvious to one of ordinary skill in the art.

For at least these reasons, independent claims 2 and 12 are patentable over all the applied reference. Thus, withdrawal of the rejection under 35 U.S.C. §103(a) is respectfully requested.

**D. Nikolaev et al. in view of Solomon et al., Shibata et al. and Vaudo et al.**

Claims 5 and 13 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Nikolaev et al. and Solomon et al. in view of Shibata et al. and Vaudo et al. The rejection is respectfully traversed.

Applicants submit that none of Nikolaev et al., Solomon et al., Shibata et al. and Vaudo et al., taken singly or in combination, teach or suggest a method for producing an Al-

containing III-V group compound semiconductor by repeating a vapor phase epitaxial growth process to deposit layers of III-V group compound semiconductors of different compositions containing Al as a group III element having a second step of reacting the halogenated product of Al and the halogenated product of group III metals other than Al produced in the first step with a gas containing a group V element at a temperature of 1200°C to 1300°C on the surface of a substrate crystal as recited in claim 5. Further, Applicants submit that none of Nikolaev et al., Solomon et al., Shibata et al. and Vaudo et al., taken singly or in combination, teach or suggest that at least one of the amount of the halogenated hydrogen used in the first step, the amount of a carrier gas for the halogenated hydrogen used in the first step, and the amount of the group V element-containing gas used in the second step is varied to deposit III-V group compound semiconductors having different compositions as required in claim 5.

As discussed with respect to claims 1, 2 and 4, Nikolaev et al., Solomon et al., Shibata et al. and Vaudo et al., taken singly or in combination, fail to teach or suggest a step of reacting the halogenated product of Al with a gas containing a group V element at a temperature of 1200°C to 1300°C. As discussed with respect to claim 4, Nikolaev et al., Shibata et al. and Vaudo et al., taken singly or in combination, fail to teach or suggest that the amount of the group V element-containing gas used in the second step is varied to deposit III-V group compound semiconductors having different compositions. Moreover, nowhere does Solomon et al. teach or suggest that at least one of the amount of the halogenated hydrogen used in the first step, the amount of a carrier gas for the halogenated hydrogen used in the first step, and the amount of the group V element-containing gas used in the second step is varied to deposit III-V group compound semiconductors having different compositions.

Because these features of independent claim 5 are not taught nor suggested by Nikolaev et al., Solomon et al., Shibata et al. and Vaudo et al., taken singly or in combination,

the applied references would not have rendered the features of claims 5 and 13 obvious to one of ordinary skill in the art.

For at least these reasons, claims 5 and 13 are patentable over all the applied reference. Thus, withdrawal of the rejection under 35 U.S.C. §103(a) is respectfully requested.

### **III. New Claim**

Nikolaev et al., Solomon et al., Shibata et al. and Vaudo et al., taken singly or in combination, fail to teach or suggest a method for growing a crystal of AlN semiconductor by vapor phase epitaxy according to claim 1, wherein the second step comprises reacting the halogenated product of Al produced in the first step with a gas containing N, as required by new claim 18. Moreover, Applicants submit that Nikolaev et al., Solomon et al., Shibata et al. and Vaudo et al., taken singly or in combination, fail to teach or suggest a method for growing a crystal of an AlN compound semiconductor having a second step of reacting the halogenated product of Al with a gas containing N at a temperature of 1200°C to 1300°C on the surface of a substrate crystal as recited in claim 1.

Nikolaev et al. merely teaches a method for producing GaN and AlGaIn. Nowhere does Nikolaev et al. teach or suggest a method for producing AlN as set forth in the method of claim 18. Nikolaev et al., Solomon et al., Shibata et al. and Vaudo et al., taken singly or in combination, fail to disclose a method for producing AlN as recited in claim 18 having a second step of reacting a halogenated product of Al with a gas containing N at a temperature of 1200°C to 1300°C on the surface of a substrate crystal.

Thus, Applicants submit that none of Nikolaev et al., Solomon et al., Shibata et al. and Vaudo et al., taken singly or in combination, teach or suggest the method for growing a crystal of AlN semiconductor by vapor phase epitaxy according to claim 1, wherein the

second step comprises reacting the halogenated product of A1 produced in the first step with a gas containing N as recited in claim 18.

**IV. Conclusion**

In view of the foregoing, it is respectfully submitted that this application is in condition for allowance. Favorable reconsideration and prompt allowance of claims 1-18 are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number set forth below.

Respectfully submitted,



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